Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Excitation of high-angular-momentum Rydberg states in a deep Ponderomotive Optical Lattice JAMIE MACLENNAN, RYAN CARDMAN, Univ of Michigan - Ann Arbor, XIAOXUAN HAN, Shanxi University, GEORG RAITHEL, Univ of Michigan - Ann Arbor — A Rydberg-atom ponderomotive optical lattice (POL) differs from a conventional optical lattice trap in that the trapping force is mainly derived from the ponderomotive force of the light field on the quasi-free Rydberg electron, and in that the size of the Rydberg atom may be comparable to the lattice spacing. Thus, the effective potential is an average over the spatial density of the Rydberg electron wavefunction and no longer follows the shape of the lattice intensity. In the deep-lattice regime of interest in this work, the POL requires a non-degenerate treatment that accounts for POL-induced state mixing within large Hilbert spaces. The resultant adiabatic energy levels are a combination of rotational and vibrational energy series near the intensity minima and maxima, and Stark-like level series near the inflection points, leading to rich unusual spectra. In the present experimental implementation, a deep cavity-generated 1064-nm POL mixes the Rydberg F-state with the high-angular-momentum states to allow three-photon excitations of the type $5S_{1/2} \rightarrow 5P_{1/2} \rightarrow 5D_{3/2} \rightarrow n(\ell \geq 3)$ that would otherwise be suppressed by electric dipole selection rules.The theoretical analysis will be reviewed and experimental progress will be presented.

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Date submitted: 02 Feb 2020 Electronic form version 1.4